

(6) Leakage current limitations shall be met between each of the point (h) leads and all pairs of tip and ring telephone connections.

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#### § 68.306 Hazardous voltage limitations.

(a) *General.* Under no condition of failure of registered terminal equipment or registered protective circuitry, or of equipment connected thereto, which can be conceived to occur in the handling, operation or repair of such equipment or circuitry, shall the open circuit voltage on telephone connections exceed 70 volts peak for more than one second, except for voltages for network control signaling and supervision, which, in any case, should be consistent with standards employed by the telephone companies.

(1) Registered terminal equipment shall assure that at the MR channel interface, no continuous ac or dc voltages appear across the tip (MR) and ring (MR) leads, from the tip (MR) lead to PBX ground, or from the ring (MR) lead to PBX ground.

(2) Registered terminal equipment shall assure that during normal operation, at an AIOD data channel interface, (i) no significant ac voltage to ground other than for data transmission appears on the tip (AI) and ring (AI) leads; (ii) no open circuit dc voltage to ground appears on the tip (AI) and ring (AI) leads other than in the range from 0 to –56.5 volts.

(3) Registered terminal equipment shall also assure that at either the MR channel interface or an AIOD data channel interface, voltage transients appearing on either the tip (AI or MR) or ring (AI or MR) to ground as a result of inductive components in the registered terminal equipment shall not be capable of delivering more than 2 joules to a 500 ohm resistive termination.

(4) *Type I E&M leads.* Conditions for “A” side of interface with conditions for “B” side in parentheses. Registered terminal equipment shall assure that the dc current in the E lead does not

exceed 100 milliamperes, no significant ac voltage to ground appears on the E&M leads,\* no significant ac or dc voltage to ground appear on the (E) & (M) leads,\* and the open circuit dc voltage to ground on the E&M leads does not exceed 56.5 volts and is not positive. M lead protection shall be provided to assure that voltages to ground do not exceed 80 volts. For relay contact implementation a power dissipation capability of 0.5 watt shall be provided in the shunt path. If the registered terminal equipment contains an inductive component in the E lead, it must assure that the transient voltage across the contact as a result of a relay contact opening, does not exceed the following voltage and duration limitations:

- (i) 300 volts peak,
- (ii) A rate of change of one volt per microsecond, and
- (iii) An 80 volt level for more than 10 milliseconds.

(5) *Type II E&M leads.* Conditions for “A” side of interface with conditions for “B” side in parentheses. Registered terminal equipment shall assure that the dc current in the E and (SB) leads does not exceed 100 milliamperes and no significant ac voltage to ground appears on the E and (SB) leads,\* no significant ac or dc voltages to ground appear on the M, SG, SB (E), (SG), and (M) leads from sources in the registered terminal equipment,\* and the open circuit dc voltage to ground on the E and (SB) leads does not exceed 56.5 volts and is not positive. If the registered terminal equipment contains an inductive component in the E or (M) lead, it must assure that the transient voltage across the contact, as a result of a relay contact opening, does not exceed the following voltage and duration limitations;

- (i) 300 volts peak,
- (ii) A rate of change of one volt per microsecond, and
- (iii) An 80 volt level for more than 10 milliseconds.

(6) *Off-premises station voltages.* (i) Talking battery or voltages applied by the PBX (or similar systems) to OPS interface leads for supervisory purposes must be negative with respect to ground, shall not exceed 56.5V dc for

\*The ac component should not exceed 5 volts peak or the dc component 5 volts, where not otherwise controlled by § 68.308.

Classes A, B, and C, and shall not have a significant ac component.\*

(ii) Ringing signals applied by the PBX (or similar systems) to OPS interface leads shall be applied for the purpose of station alerting only, and shall comply with requirements in paragraph (d) of this section. Ringing voltages shall be applied between the ring conductor and ground.

(7) For Local Area Data Channel interfaces, during normal operating modes including terminal equipment initiated maintenance signals, registered terminal equipment shall assure, except during the application of ringing (limitations specified in paragraph (d) of this section), with respect to telephone connections (tip, ring, tip 1, ring 1) that:

(i) Under normal operating conditions, the rms current per conductor between short-circuited conductors, including dc and ac components, does not exceed 350 milliamperes. For other than normal operating conditions, the rms current between any conductor and ground or between short-circuited conductors, including dc and ac components, may exceed 350 milliamperes for no more than 1.5 minutes.

(ii) The dc voltage between any conductor and ground does not exceed 80 volts. Under normal operating conditions it shall not be positive with respect to ground (though positive voltages up to 80 volts may be allowed during brief maintenance states);

(iii) Ac voltages are less than 42.4 volts peak between any conductor and ground, (Terminal equipment shall comply while other interface leads are both (A) unterminated and (B) individually terminated to ground); and,

(iv) Combined ac and dc voltages between any conductor and ground are less than 42.4 volts peak when the absolute value of the dc component is less than 21.2 volts, and less than  $(28.8 + 64 \times V_{dc})$  when the absolute value of the dc component is between 21.2 and 80 volts.

(8) During normal operation, registered terminal equipment for connection to ringdown voiceband private line interfaces or voiceband metallic channel interfaces shall assure that:

(i) Ringing voltage is used for alerting only, does not exceed the voltage

and current limits specified in paragraph (d), and is:

(A) Applied to the ring conductor with the tip conductor grounded for 2-wire interfaces, or

(B) Simplex on the tip and ring conductors with ground simplex on the tip (1) and ring (1) conductors for 4-wire interfaces.

(ii) Except during the signaling mode or for monitoring voltage, there is no significant positive dc voltage with respect to ground (not over +5 volts):

(A) For 2-wire ports between the tip lead and ground and the ring lead and ground, and

(B) For 4-wire ports between the tip lead and ground, the ring lead and ground, the tip 1 lead and ground, and the ring 1 lead and ground.

(iii) The dc current per lead, under short circuit conditions shall not exceed 140 milliamperes.

(b) *Connection of nonregistered equipment to registered terminal equipment or registered protective circuitry—(1) General.* Leads to, or any elements having a conducting path to telephone connections, auxiliary leads or E&M leads shall:

(i) Be reasonably physically separated and restrained from and be neither routed in the same cable as nor use the same connector as leads or metallic paths connecting power connections;

(ii) Be reasonably physically separated and restrained from and be neither routed in the same cable as nor use adjacent pins on the same connector as metallic paths to leads to non-registered equipment, when specification details provided to the Commission pursuant to §68.200(g) do not show that interface voltages are less than non-hazardous voltage source limits in §68.306(b)(4).

(2) *Connections to registered terminal equipment.* The voltage measurable between auxiliary leads, auxiliary leads to ground, E&M leads and ground, tip and ring, tip to ground, ring to ground, tip 1 and ring 1, tip 1 to ground, and ring 1 to ground shall not exceed 70 volts peak for more than 1 second, with tip to ring, tip 1 to ring 1, and auxiliary lead to auxiliary lead each terminated with 1500 ohms center-tapped through 1000 ohms to ground and each E&M

lead terminated in 1500 ohms to ground, if 120 volts rms 60 Hz, ac is applied between all connections to other equipment tied together (except connections to non-hazardous voltage sources) and ground. The source shall not be limited to less than 20 amperes continuously, not to less than 50 amperes for 1 minute, and shall not be interrupted by an overcurrent device permitting less total energy flow than a 20 ampere time delay fuse or breaker.

(3) *Connections to registered protective circuitry.* The voltage measurable between auxiliary leads, auxiliary leads to ground, E&M leads and ground, tip and ring, tip to ground, ring to ground, tip 1 and ring 1, tip 1 to ground, and ring 1 to ground shall not exceed 70 volts peak for more than 1 second, with tip to ring, tip 1 to ring 1 and auxiliary lead to auxiliary lead each terminated with 1500 ohms, center-tapped through 1000 ohms to ground, and each E&M lead terminated in 1500 ohms to ground if either 120 or 300 volts rms to 60 Hz. ac is applied:

(i) Between all protective circuitry connections other than telephone connections (and connection to non-hazardous voltage sources), tied together and ground; and

(ii) Across all protective circuitry connections, other than telephone connections (and connections to non-hazardous voltage sources) which have a transmission path to the telephone connections, with alternative leads grounded; under all reasonable applications of earth ground to the protective circuitry. The source shall not be limited to less than 20 amperes continuously, nor to less than 50 amperes for 1 minute, and shall not be interrupted by an overcurrent device permitting less total energy flow than a 20 ampere time delay fuse or breaker.

(4) *Non-hazardous voltage source.* A voltage source is considered a non-hazardous voltage source if it conforms with the requirements of §§ 68.302, 68.304, and 68.306(b)(1), with all connections to the source other than primary power connections treated as “telephone connections,” and if such source supplies voltages no greater than the following under all modes of operation and of failure:

(i) Ac voltages less than 42.4 volts peak;

(ii) Dc voltages less than 80 volts; and

(iii) Combined ac and dc voltages less than 42.4 volts peak when the absolute value of the dc component is less than 21.2 volts and less than  $(28.8 + 0.64 \times V_{dc})$  when the absolute value of the dc component is between 21.2 and 80 volts.

(c) *Hazards from exposed surfaces (to be applied for intentional conductive paths to ground as required by § 68.304).* The voltage measurable between auxiliary leads, auxiliary leads to ground, E&M leads and ground, tip and ring, tip and ground, ring and ground, tip 1 and ring 1, tip 1 and ground, ring 1 and ground, shall not exceed 70 volts peak for more than 1 second, with tip to ring, tip 1 and ring 1, and auxiliary lead to auxiliary lead each terminated with 1500 ohms, center-tapped through 1000 ohms to ground, and each E&M lead terminated in 1500 ohms to ground, if 120 volts rms 60 Hz. ac is applied between conductive exposed surfaces and ground. The source shall not be limited to less than 20 amperes continuously, nor to less than 50 amperes for 1 minute, and shall not be interrupted by an overcurrent device permitting less total energy flow than a 20 ampere time delay fuse or breaker.

(d) *Ringng sources.* Ringng sources, except for class A OPS interfaces, shall meet all of the following restrictions:

(1) The ringng signal shall use only frequencies whose fundamental component is equal to or below 70 Hz.<sup>2</sup>

(2) The ringng voltage shall be less than 300 V peak-to-peak and less than 200 V peak-to-ground across a resistive termination of at least 1 megohm.

(3) The ringng voltage shall be interrupted to create quiet intervals of at least one second (continuous) duration each separated by no more than 5 seconds. During the quiet intervals, the voltage to ground shall not exceed the voltage limits given in paragraph (a)(6)(i) of this section.

(4) As specified below, ringng sources shall be required to (a) include a series current-sensitive tripping device in the ring lead which will trip ringng as specified in Figure 68.306(d), and/or (b)

<sup>2</sup>33 Hz may be the highest frequency necessary for OPS service.

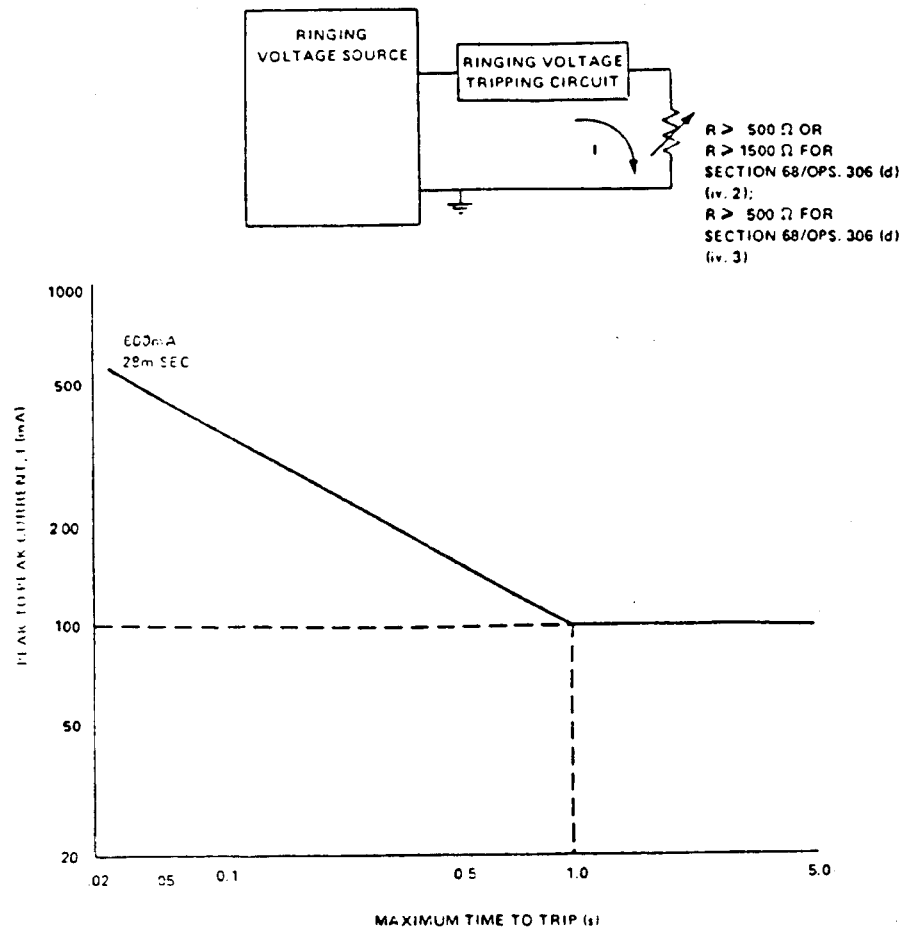
provide a voltage to ground (monitoring voltage) on the tip or ring conductor with a magnitude of at least 19 volts peak (but may not exceed the voltage limits given in paragraph (a)(6)(i) of this section) whenever the ringing voltage is not present (idle state). Tripping devices and/or monitoring voltages are required dependent upon the current flow through a specified resistance connected between the ringing source (R(OPS)) and ground as follows:

(i) If the current through a 500 ohms (and greater) resistor does not exceed 100 mA peak-to-peak, neither a tripping device nor a monitoring voltage are required, or

(ii) If the current through a 1500 ohms (and greater) resistor exceeds 100 mA peak-to-peak, the ringing source

shall include a tripping device. If the tripping device meets the operating characteristics as specified in Figure 68.306(d) with R=500 ohms (and greater), then no monitoring voltage is required. If, however, the tripping device only meets the given operating characteristics with R=1500 ohms (and greater), then the ringing source must also include a monitoring voltage as described above, or

(iii) If the current through a 500 ohms (and greater) resistor exceeds 100 mA peak-to-peak but does not exceed this value of current with a 1500 ohms (and greater) termination, the ringing source shall include either a tripping device which meets the operating characteristics as specified in Figure 68.306(d) with R=500 ohms (and greater), or a monitoring voltage.



RINGING VOLTAGE TRIP CRITERIA

Fig. 68.306(d)

[45 FR 20854, Mar. 31, 1980, as amended at 45 FR 54342, Aug. 15, 1980; 45 FR 61632, Sept. 17, 1980; 47 FR 39686, Sept. 9, 1982; 51 FR 945, Jan. 9, 1986; 51 FR 16689, May 6, 1986; 60 FR 54814, 54815, Oct. 26, 1995]

**§ 68.308 Signal power limitations.**

(a) *General.* Limitation on signal power shall be met at the interface for all 2-wire network ports, tip and ring conductors to PSDS Types II and III, and, where applicable to services, both transmit and receive pairs of all 4-wire network ports. Signal power measurements will be made using terminations as specified in each of the following limitations. The transmit and receive pairs of 4-wire network ports shall be measured with the pair not under test connected to a termination equivalent to that specified for the pair under test. Through-gain limitations apply only in the direction of transmission to the network.

(b) *Voice band metallic signal power—*  
(1) Limitations at the interface on internal signal sources not intended for network control signaling.

(i) For registered terminal equipment or registered protective circuitry, connected to interfaces associated with services contained in § 68.2(a) (1), (2), and (7), other than data equipment or data protective circuitry which is registered in accordance with § 68.308(b)(4), the maximum power of other than live voice signals delivered to a loop simulator circuit shall not exceed -9dB with respect to one milliwatt, when averaged over any 3-second interval. No manufacturing tolerance is allowed which would permit this power to be exceeded by any unit of equipment.

(ii) For tie trunk type interfaces, the maximum power of other than live voice signals delivered to a 600 ohm termination shall not exceed the following:

MAXIMUM POWER WITH RESPECT TO ONE MILLIWATT WHEN AVERAGED OVER ANY 3-SECOND INTERVAL

2-wire	4-wire Lossless	4-wire CTS <sup>(b)</sup>
- 15 dB <sup>(a)</sup> .....	- 15 dB <sup>(a)</sup> .....	- 19 dB, nom.

NOTES: (a) The maximum signal power may be exceeded by as much as 1.0 dB by a single unit of equipment or circuitry, provided that the power averaged over all units of production, complies with the specified limitations.

(b) The 4-Wire CTS shall meet the requirements for Tie Trunk Transmission Interfaces as defined in § 68.3.

(iii) For OPS lines, the maximum power of other than live voice signals delivered to an OPS line simulator circuit shall not exceed -13 dB with re-

spect to one milliwatt, when averaged over any 3-second interval.

(iv) For AIOD channels, the maximum signal power delivered to an AIOD data channel simulator circuit in each of the following operating states shall not exceed -4 dB with respect to one milliwatt averaged over any 3-second time interval:

Simulator circuit <sup>1</sup>	AIOD tip and ring <sup>2</sup>
1 .....	- 42.5-56.5
2 .....	0
3 .....	0

<sup>1</sup> Operating state of simulator circuit.

<sup>2</sup> Remote terminal equipment open circuit DC volts to ground on AIOD tip and ring.

The maximum signal power may exceed -4 dB with respect to one milliwatt by as much as 1.0 dB provided that the power averaged over all units of the equipment complies with the specified maximum.

NOTE: The maximum signal power may be exceeded by as much as 1.0 dB by a single unit of equipment or circuitry, provided that the power, averaged overall units of production, complies with the specified limitations.

(v) For registered test equipment or registered test circuitry the maximum signal power delivered to a loop simulator circuit shall not exceed 0 dBm when averaged over any 3-second interval. No manufacturing tolerance is allowed which would permit this power to be exceeded by any unit of equipment.

(vi) For voiceband private lines using ringdown or inband signaling the maximum power of other than live voice signals delivered to a 600 ohm termination shall not exceed -13dBm when averaged over any 3-second interval.

(vii) For voiceband private lines using inband signaling in the band 2600±150 Hz, the maximum power delivered to a 600-ohm termination shall not exceed -8 dBm during the signaling mode. The maximum power delivered to a 600 Ohm termination in the on-hook steady state supervisory condition shall not exceed -20 dBm. The maximum power of other than live voice signals delivered to a 600-ohm termination during the non-signaling mode and for other inband systems shall not exceed -13dBm when averaged over any 3-second interval. The maximum signal power may be exceeded by as much as 1.0 dB by a single unit of equipment or circuitry, provided that the power averaged over all